M109A6 PALADIN: THE CHANGING FACE OF DOD ACQUISITION

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Background

During the last 10 to 15 years, acquisition and logistic reforms have changed the way the military equips the soldier in the field. While strategies have changed, the goal of the acquisition community remains the same—to provide our soldiers with an overwhelming technological advantage. With the implementation of acquisition reform, the refined focus is to remain on the forefront of defense technologies while achieving low life-cycle cost (LCC).

Since its inception, the Office of the Program Manager for Paladin/Field Artillery Ammunition Support Vehicle (FAASV) has been a strong proponent and practitioner of these new initiatives. Team Paladin has been recognized for its success through several efforts and on several programs. The vehicle's main fire control computer received the DOD Standardization Award for Excellence in 1997. However, the most successful and innovative initiative run by Team Paladin to date is the procurement, fielding, and support of the Paladin's primary inertial/Global Positioning System (GPS) navigation system, the Dynamic Reference Unit-Hybrid (DRU-H).

The M109A6 Paladin

Since being fielded to the U.S. Army, the M109A6 Paladin self-propelled howitzer has become and remains the U.S. Army's premier artillery system. The Paladin development effort began with the goal of enhancing the reliability, availability, maintainability, survivability, lethality, and responsiveness of 155mm artillery. Some of the major improvements Paladin M109A6 offers over the M109A5 include enhanced armament, crew safety enhancements, and automotive upgrades. The most significant advantage of the A6 is the onboard electronic fire control, communication, and navigation systems that allow for "shoot-and-scoot" capability.

Electronic Systems

The Paladin's systems, including fire control, communication, and navigation, work together to make the Paladin an extremely effective tactical weapon. These systems include several individual electronic components. The fire control system consists of a main computer, a display screen, and a keypad. The communication system is centered on the Army's standard radio, the Single Channel Ground and Airborne Radio

The DRU-H provides continuous position and pointing data to the M109A6 fire control computer.

The M109A6 Paladin is a 155mm self-propelled howitzer, equipped with automated fire control, communications, and navigation systems.

The FAASV (left) supports the Paladin (right) in the field.

System. The main component of the navigation system is the DRU-H.

Paladin was initially fielded in June 1993 with a fire control system that was built to a full technical data package. The current system, the Automatic Fire Control System (AFCS), was fielded to the entire Paladin fleet in 1997. The Paladin's main fire control computer is based on commercial or PC technology. The AFCS Computer Unit (ACU) uses rotating hard drive, a Pentium processor, and other commercial technologies to perform all fire control functions onboard. Designed and procured using a performance specification based on commercial specifications and standards, the ACU is approaching obsolescence but continues to operate admirably considering its commercial off-the-shelf technology. Personnel conducting sample data collection (SDC) for the Office of the Program Manager for Paladin estimate the mean time between failure (MTBF) for the ACU to be just above 2,000 hours. By maximizing the use of commercial products in the AFCS, the cost of providing onboard fire control has drastically decreased since the first fielding of the Paladin.

DRU-H

Although the fielding of the ACU was a significant accomplishment, the success of that item pales in comparison to the M109A6's main navigation unit, the DRU-H. Fielded in 1993 as an upgrade to the original DRU, the DRU-H performs several functions for the crew. With or without the Precision Lightweight GPS Receiver (PLGR), the DRU-H provides accurate position, gun-tube pointing, and attitude data to the fire control system. When the PLGR is installed, the DRU-H is bounded by the PLGR for position data because of the PLGR's greater accuracy and consistency over time. However, the PLGR does not readily provide pointing data to the AFCS. This capability is provided solely by the DRU-H. The DRU-H also provides gun slew rate feedback.

The DRU-H has met and exceeded the requirements set during the procurement phase. The most impressive statistic is the DRU-H's reliability. The same data collection activity that reports the ACU's reliability data also collects data on the DRU-H. While the ACU achieves relatively good reliability numbers, the DRU-H reliability numbers are staggering. Almost 10 years after the initial fielding of the item, the reliability data continues to be impressive. The DRU-H has shown only 14 failures at SDC sites during the past 6 years. This equates to an MTBF of more than 15,000 hours. When reviewing the performance of an entire group of fielded DRU-Hs, the reliability data is even more impressive. With 1,200 units in the field, only 23 DRU-Hs required repair last year. With an estimated average running time of more than 700 hours per unit per year, this places the estimated field MTBF above 30,000 hours.

The DRU-H achieves this outstanding performance under the most severe of gunfire shock environments. Mounted directly to the vehicle's trunion, the DRU-H is subjected to the full effects of the firing blast and recoil shock of each 155mm round. It is also subjected to extreme temperatures and other detrimental environments. The DRU-H has continually survived the worst aspects of the battle environment. This performance can in part be attributed to the use of military grade components, but the procurement strategies and contracting tools

used in this acquisition also played a major part in the program's success. This exceptional performance is attributed to the LCC acquisition strategy for the DRU-H.

Innovation With Logistics

Development of the Modular Azimuth Position System, which included the DRU, began in 1984. In 1986, the procurement of the DRU for the M109 began with a performance specification as the sole technical document. Although procuring to a performance specification is a standard practice today, this was a rarity for the Army in 1986. The DRU was originally designed to a Military Standard (MIL-D-70789(AR)). In 1991, the DRU was upgraded to interface with the PLGR, thus developing the DRU-H. The DRU Program strategy also made use of an Air Force acquisition model that stresses LCC and contractor logistics support (CLS). Based on those strategies, the Office of Personnel Management decided to trouble-shoot the DRU-H at the line replacement level. Using the DRU-H Built-In Test eliminated any need to invest in interim support equipment or to supply large quantities of spare subassemblies. All failures are simply returned to the contractor for repair.

From the initiation of this program, a conscious decision was made to focus on LCC and CLS for all facets of maintainability, including obsolescence. The emphasis on CLS allowed the Army to eliminate the overhead expenses of establishing and maintaining an organic depot repair capability, which would normally include the cost of test equipment, personnel, and facilities. In addition, neither technical data nor data rights for proprietary software were purchased by the government for support of the DRU-H; the only documentation required was the performance specification (MIL-PRF-71185).

In place of establishing the archetypical logistics solution, this program included innovative acquisition tools such as a Reliability Improvement Warranty (RIW). This tool was also adapted from Air Force acquisition models. At the time, the Air Force had an RIW in place for its form, fit, function (F3) multiple application inertial navigator. The basis of such an acquisition is to make the prime contractor ultimately responsible for the reliability of the product. The RIW motivates the contractor to make product improvements and to implement changes as more reliability data are obtained. The Army leveraged this RIW concept in the procurement of the DRU-H because the DRU-H design had 80 percent commonality.

Under an RIW, the contractor is bound to a fixed price for total support during the warranty period. This provides the contractor a direct financial incentive for improved reliability. Because the DRU-H is based on a proven Air Force design, the contractor has the product confidence to offer a firm fixed price per repair. Because of the excellent reliability, the contractor is able to support the repair contracts for more than 16,000 navigation units from the same repair center location. Years later, these innovative acquisition techniques have benefited the acquisition community, the contractor, and ultimately the U.S. Army.

Pros/Cons Of Success

Even though this acquisition was a tremendous success story to the Army as a whole and to the taxpayer, there was a downside for the soldier in the field. The problem is one of significant repair cost to the soldier as compared to the cost from the vendor. Unit production cost for a new DRU-H to the Army is $88,000 per unit. The cost to the Army for a repair ranges from $600-$8,800, depending on type and severity of failure. However, the cost to the soldier is $47,000. This significant cost difference is driven by the Army Working Capital Fund (AWCF) system. As the Army transitions to commercial business practices and contractor logistics support, the AWCF system will also need to be addressed to ensure that the savings achieved by this transition are appropriately addressed and most effectively leveraged. The real benefit to minimizing or circumventing the cost of AWCF will be the ability to pass the savings on to the ultimate customer, the soldier.

Conclusion

The M109A6 Paladin is and will continue to be the premier artillery piece for the U.S. Army. Further improvements will have to be procured and fielded to meet future operational capabilities. The Army's identified need for accurate, timely, and reliable indirect fires will fuel the future upgrades of this vehicle. The lessons learned are most applicable to electronic devices and are currently being applied to the acquisition of the Paladin's next generation of fire control. To guarantee an overwhelming fighting force, the Army must leverage these successes and continue to adopt both innovative technological and business strategies.

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